

ENGINEERING DIVISION WORKING COPY  
RETURN TO FILE

DESIGN MEMORANDUM

on

PORTSMOUTH HARBOR and PISCATAQUA RIVER

NEW HAMPSHIRE and MAINE

U. S. ARMY ENGINEER DIVISION, NEW ENGLAND  
CORPS OF ENGINEERS  
WALTHAM, MASSACHUSETTS

April 1964

U. S. ARMY ENGINEER DIVISION, NEW ENGLAND  
CORPS OF ENGINEERS

424 TRAPELO ROAD  
WALTHAM, MASS. 02154

ADDRESS REPLY TO:  
DIVISION ENGINEER

REFER TO FILE NO.

NEDED-R

15 April 1964

SUBJECT: Design Memorandum on Portsmouth Harbor and  
Piscataqua River, New Hampshire and Maine

TO: Chief of Engineers  
ATTN: ENG CW-E  
Washington, D. C.

1. In accordance with EM 1110-2-1150, Engineering and Design, Definite Project Studies, dated 15 January 1962, there are inclosed four (4) copies of the Design Memorandum on the subject project. The work to be undertaken involves dredging operations with no special design or excavation problems. The Design Memorandum is approved in accordance with paragraph 6 (b) of the above-referenced authority.

2. Planning on this project is 100% complete, with the exception of execution of formal assurances by the State of Maine. This is currently in progress. Formal assurances have been accepted from the State of New Hampshire.

Incl (quad)  
as

P. C. HYZER  
Brigadier General, USA  
Division Engineer

U. S. ARMY ENGINEER DIVISION, NEW ENGLAND  
CORPS OF ENGINEERS  
424 TRAPELO ROAD  
WALTHAM, MASS. 02154

NEDED-R

15 April 1964

DESIGN MEMORANDUM  
ON  
PORTSMOUTH HARBOR AND PISCATAQUA RIVER  
NEW HAMPSHIRE AND MAINE

PERTINENT DATA

1. A summary of the physical features and costs of the existing project for Portsmouth Harbor and Piscataqua River, New Hampshire and Maine is as follows:

<u>Features</u>	<u>Present Estimate (1964)</u>
Completed project modifications	\$ 1,173,000
Uncompleted project modifications	
Widening the existing 35-foot Federal channel at bends by the removal of ledge rock areas in the vicinity of Henderson Point, Gangway Rock, Badgers Island, the Maine-New Hampshire Interstate Bridge and Boiling Rock, and extending the channel upstream from above Boiling Rock to a point about 1,700 feet above the Atlantic Terminal Sales dock in Newington generally 400 feet wide and 35 feet deep with maneuvering basins above Boiling Rock and at the head of the project.	<u>7,000,000</u>
Total Project Cost	\$ 8,173,000

## PROJECT AUTHORIZATION

2. Authorization. The uncompleted modification for the improvement of Portsmouth Harbor and Piscataqua River was authorized by the River and Harbor Act of 23 October 1962. The project, as authorized, modified the existing project to provide for widening the existing 35-foot Federal channel at bends by the removal of ledge rock areas in the vicinity of Henderson Point, Gangway Rock, Badgers Island, the Maine-New Hampshire Interstate bridge and Boiling Rock, and for extending the channel from above Boiling Rock to a point about 1,700 feet above the Atlantic Terminal-Sales dock in Newington generally 400 feet wide and 35 feet deep below mean low water with maneuvering basins above Boiling Rock and at the head of the project; all generally in accordance with the plan of the Division Engineer and with such modifications thereof, as in the discretion of the Chief of Engineers, may be advisable.

3. The project modification was authorized subject to the requirements that local interests agree to:

a. Hold and save the United States free from damages due to the construction and maintenance of the improvements.

b. Provide all lands, easements and rights-of-way necessary for the construction and subsequent maintenance of the project and for aids to navigation upon the request of the Chief of Engineers; and

c. Provide and maintain without cost to the United States depths in berthing areas and local access channels serving the terminals commensurate with the depths provided in the related project areas.

The authorizing document also provides that when the necessary conditions of local cooperation for either widening the existing Federal project or extending the channel upstream from Boiling Rock have been fulfilled, construction may be initiated on that part of the plan irrespective of the status of local cooperation for the other part.

4. The original project in the waterway was for Portsmouth Harbor only and was authorized by the River and Harbor Act of 1879 and modified in 1890. It provided for a stone breakwater extending

from Goat Island to Newcastle Island, the removal of a portion of ledge rock on the southeast side of Badgers Island to a depth of 18 feet below mean low water, and the removal of Pier rock to a depth of 12 feet below mean low water.

5. Work on the project was initiated in 1879 and the entire project was completed in 1892. The breakwater, which was designed to eliminate dangerous cross currents in the vicinity of Goat Island ledge, was completed in 1881. Removal of part of Gangway Rock to 20 feet began in 1881 and was completed in 1888. Removal of ledge at the southwest point of Badgers Island to 18 feet was started in 1881 and completed in 1891. Removal of Pier Rock to 12 feet as authorized by the River and Harbor Act of 1890 was accomplished in the two-year period 1891 to 1892. The total expenditures in Portsmouth Harbor for these early projects were \$130,396.61, all of which was for new work.

6. The River and Harbor Act of 1954 provided for project modification by the removal of ledge rock in the vicinity of Gangway Rock, the southwest point of Badgers Island and Boiling Rock to 35 feet below mean low water, as described in House Document No. 556, 82d Congress, 2d Session. This work was initiated and completed in 1956 at a cost of \$1,173,440, all of which was for new work. The total costs on the completed project are \$1,303,832.61. The only requirement of local cooperation on the existing project modification completed in 1956 was that local interests hold and save the United States free from damages. This requirement was met.

7. The improvement being planned in this design memorandum is that authorized by the River and Harbor Act of 1962, as described in paragraph 2 above. Advance planning only has been done on this uncompleted project modification. The existing project including the uncompleted project modification is shown on the attached project plan. Requirements of local cooperation for this uncompleted modification are described in paragraph 3 above.

8. There have been no overall improvements made in the waterway by State or local authorities for the benefit of general navigation. However, the City of Portsmouth, New Hampshire and the Town of Kittery, Maine, have provided free public landings for the use of small craft in Portsmouth Harbor. About 60 years ago, the Navy removed a portion of Henderson Point to improve navigation

into the Portsmouth Naval Base. In August 1960, a portion of the shoal in the upper reach of the river was dredged by the New England Tank Industries to allow T-2 tankers access to their new terminal, then being constructed to handle petroleum products for Pease Air Force Base. The New Hampshire Port Authority is presently constructing, at a cost of about \$1,000,000, a modern State Pier capable of handling large deep-draft ships.

### INVESTIGATIONS

9. Physical investigations carried out in support of the survey report contained in House Document No. 482, 87th Congress, 2d Session, were made in 1955, 1960 and 1961 and consisted of hydrographic, topographic and probing surveys.

10. Subsequent to project authorization in 1962, probing surveys were accomplished in April 1963 by contract. Detailed probings were made on 50-foot spacing over known rock areas and in areas where rock and hard material was anticipated. Probings were taken to a depth of 40 feet below mean low water or to refusal. A total of 20 core borings were made in the probed areas. Soundings were made over the entire project in 1963 and 1964.

### LOCAL COOPERATION

11. The requirements of local cooperation, as required by the authorizing document, are stated in paragraph 3 above. Since the Piscataqua River forms a portion of the boundary between the States of New Hampshire and Maine, it is necessary that assurances, that the requirements of local cooperation will be met, be executed by both the State of New Hampshire and the State of Maine. Formal assurances have been executed by the State of New Hampshire and accepted by the Division Engineer on 27 January 1964. Receipt of assurances executed by the State of Maine is expected prior to completion of plans and specifications. The views and concurrence with the project plan by the Governors of the States of New Hampshire and Maine, Port Authorities of each State, and shipping interests, including the American Merchant Marine Institute, were obtained during the survey study. The project plan has been reviewed with these interests in various conferences during the construction planning phase. The names of some of the principal officers and representatives contacted during the preconstruction planning phase are listed below:

Governor John W. King, State House, Concord, N. H.  
Governor John H. Reed, State House, Augusta, Me.  
Mr. David H. Stevens, Chairman, Maine-New Hampshire  
Interstate Bridge Authority, Augusta, Me.  
Mr. John O. Morton, Maine-New Hampshire Interstate  
Bridge Authority, Concord, N. H.  
Mr. Eugene P. Soles, Chairman, New Hampshire State  
Port Authority, Portsmouth, N. H.  
Mr. Edward Langlois, General Manager, Maine Port  
Authority, Portland, Maine  
Commander A. J. Thomas, USN, Portsmouth Naval Base  
Capt. Chester T. Swalm, Pilot, Portsmouth Naval Shipyard  
Capt. Shirley H. Holt, Jr. Pilot, Portsmouth Naval  
Shipyard  
Mr. Warren K. Hale, Asst. General Manager, Engineering,  
Boston and Maine Railroad, Boston, Mass.  
City Manager, Robert Violette, Portsmouth, N. H.

#### LOCATION AND TRIBUTARY AREA

12. Portsmouth Harbor is 45 miles northeast of Boston Harbor and 37 miles southwest of Portland Harbor, at the mouth of the Piscataqua River. The river is about 13 miles long and forms a portion of the boundary of the States of Maine and New Hampshire. The waterway is characterized by sharp bends, swift current, and a tortuous natural channel with depths up to 70 feet and generally in excess of 35 feet at mean low water to a point about 0.7 mile above Boiling Rock. The river drains large tidal basins and is subject to very strong currents that limit navigation by large vessels to periods of slack water. The mean tidal range is 7.8 feet; the spring range, 9.0 feet. Rapid tidal currents exist through the entire river. The average velocity at full strength of the current varies from about 2.6 knots to 4.0 knots. Navigation of the river is hazardous because of submerged ledges at bends and constricted areas in the winding channel.

13. Two bridges cross the main channel of the river within the harbor area. The Interstate Bridge at Nobles Island is a vertical lift combined highway and railroad bridge with a horizontal clearance of 200 feet, and a minimum vertical clearance of 135 feet above mean high water in the open position and 10.2 feet in the closed position. The bridge spans the river from the city of Portsmouth to the town of

Kittery and is located about 4.0 miles from the mouth. The Memorial Highway bridge at Badgers Island is a vertical lift bridge with a horizontal clearance of 260 feet and a minimum vertical clearance of 150 feet above mean high water in the open position and 19.1 feet in the closed position. The bridge crosses the river from the city of Portsmouth to Kittery as a part of U.S. Route #1, and is located about 3.5 miles above the river mouth.

14. The city of Portsmouth and the town of Newington in New Hampshire and the towns of Kittery and Eliot in Maine comprise the immediate tributary area to Portsmouth Harbor and the Piscataqua River. The principal industries of the area are the manufacture of shoes and gypsum products, generation of electrical power, operation of bulk coal and petroleum production terminals, the Portsmouth Naval Base at Kittery and the U.S. Air Force Base at Newington. Within 15 miles of Portsmouth are the cities of Dover and Somersworth and the towns of Durham, Newmarket and South Berwick. These centers are principally engaged in the manufacture of textiles, leather and leather products and electrical equipment. The Boston and Maine Railroad serves most communities including Portsmouth and Kittery, with a branch line along the westerly bank of the Piscataqua River on which the major industries are located. The area is also served by bus lines and trucking companies operating over a network of hard surfaced roads.

15. Waterfront terminals in the project area are situated chiefly on the south bank of the Piscataqua River in Portsmouth and Newington, New Hampshire. The U. S. Navy Yard is on the opposite bank in Kittery, Maine. A total of 18 piers, wharves and landings represent the available terminals for handling the port's commerce, 80% of which is in petroleum and petroleum products. The greater tonnages of petroleum products are received at five major waterfront terminals.

### PROJECT PLAN

16. The project plan considered the most feasible and economical to accomplish the authorized work includes the removal and disposal of ledge rock and ordinary materials to a depth of 35 feet below mean low water in the Federal waterway from Henderson Point to Newington beginning with widening the bends at Henderson Point, Gangway Rock, and the southwesterly point of Badger's Island. It



includes widening the channel between Badger's Island and Nobles' Island and widening the bend to the east of the Maine-New Hampshire Interstate Highway Bridge to provide a suitable approach to the bridge. During the course of the extensive investigations carried on in connection with the known rock areas, a locomotive was revealed to be on the channel bottom near the south edge of the channel west of the interstate bridge, lying partially on a shoal area to be removed, and projecting in toward the middle of the channel. Removal of the shoal and the locomotive by drilling and blasting is of concern to the Maine-New Hampshire Interstate Bridge Authority because of the possible adverse effect such operations would have on the bridge foundation. In order to obviate such effect, the project plan proposes to realign the channel limit to restrict operations to whatever dredging is needed to permit vessels to clear the bridge. Further, it is proposed to physically move the locomotive to deep water close by, away from the channel. Farther upstream, the bend at Boiling Rock is to be widened, including removal of the pinnacle of Boiling Rock, and a 950-foot wide turning basin is to be constructed immediately upstream of Boiling Rock. The project plan also includes extending the channel from Boiling Rock to Newington at a depth of 35 feet generally 400 feet wide, with a turning basin of the same depth at the head of the authorized project of sufficient area to enable the larger tankers to turn from adjacent piers prior to proceeding downstream to the ocean.

17. The project plan involves the drilling, blasting and removal of about 106,000 cubic yards of ledge rock and 120,000 cubic yards of overlying materials, the removal of about 125,000 cubic yards of hard material, and the removal of 284,000 cubic yards of ordinary materials, all to a required depth of 35 feet plus 2 feet allowable overdepth. The two-foot allowable overdepth provides for inaccuracies in dredging process at the specified depth and insures attainment of project depth. Removal of these materials will be accomplished by means of a bucket dredge with disposal in an approved dumping area at sea.

#### DEPARTURES FROM PROJECT DOCUMENT PLAN

18. The present project plan is essentially the same as that recommended in the authorizing document. A minor change in the alignment of the turning basin at the upstream limit of the Federal project has been made at the request of shipping interests. The change was requested to better accommodate the swing of the larger

tankers using the docks and piers adjacent to the basin. Another minor change in the project plan is the realignment of the channel limit at the upstream side of the Interstate Bridge. Neither of the changes will significantly affect the project cost or scope, or produce any adverse affect on navigation.

### COST ESTIMATES

19. The estimate of project cost determined in the authorizing document was based on random probings and hydrographic surveys made in 1955, 1960 and 1961 during the preauthorization study phase and indicated that the materials to be removed consisted of ledge rock and sand, gravel and mud. It was estimated that 225,000 cubic yards of ledge rock and 255,000 cubic yards of ordinary material would be required to be removed from within the project limits. Quantities were in terms of in-place measurement and included an allowance of 2 feet overdepth in each case, side slopes of 1 on 1 in rock areas and 1 on 3 in ordinary material. It was anticipated that dredging would be accomplished by dipper dredge with disposal at sea.

20. The current estimate of cost is based on quantities determined by detailed soundings and boring and probing surveys made in April and May 1963, and include an allowance of two feet of overdepth dredging to provide for inaccuracies in the dredging operations. Additional detailed probings were made in March 1964 in the shoal area where the locomotive is submerged. The present estimate of project cost is based on dipper dredge operation with disposal in an approved dumping ground at sea, prices prevailing in April 1964, and actual costs incurred during the advance engineering phase plus related government costs.

21. Current Estimate of Costs (April 1964)

09 Contract - Channels

Rock Removal	
106,000 c.y. @ \$27.00 c.y.	\$ 2,862,000
Overburden Material	
120,000 c.y. @ \$6.00 c.y.	720,000
Hard Materials	
125,000 c.y. @\$10.00 c.y.	1,250,000
Ordinary Materials	
284,000 c.y. @ \$2.00	568,000
Removal of Engine	<u>75,000</u>
	\$ 5,475,000
Contingencies 15%	<u>825,000</u>
09 Total Contract Costs	\$ 6,300,000
30 Engineering and Design	165,000
31 Supervision and Administration	<u>535,000</u>
Total Project Construction Cost (C of E Funds only)	\$ 7,000,000
Aids to Navigation (Coast Guard)	<u>21,000</u>
Total Project Costs (Federal funds only)	\$ 7,021,000

## 22. Comparison of Costs

	<u>Document Estimate (Jan 1962)</u>	<u>Latest Approved Estimate (Jan 1964)</u>	<u>Current Estimate (Apr 1964)</u>
Volumes: Channel			
Rock Removal	225,000 cy	225,000 cy	106,000 cy
Overburden materials	-	-	120,000 cy
Hard materials	-	-	125,000 cy
Ordinary Materials	255,000 cy	255,000 cy	284,000 cy
Total Volumes	480,000 cy	480,000 cy	635,000 cy
Contracts: Channel			
Rock Removal	\$ 5,625,000	\$ -	\$2,862,000
Overburden materials	-	-	720,000
Hard materials	-	-	1,250,000
Ordinary materials	510,000	-	568,000
Removal of engine	-	-	75,000
Contingencies	915,000	-	825,000
Total Contracts	\$ 7,050,000	\$ 7,800,000	\$5,300,000
Preauthorization studies	20,000	deleted	-
Engineering & Design	100,000	165,000	165,000
Supervision & Adm.	350,000	535,000	535,000
	\$ 7,520,000	\$ 8,500,000	\$ 7,000,000
Total Construction Cost (C of E)	\$ 7,520,000	\$ 8,500,000	\$ 7,000,000
Aids to Navigation (Coast Guard)	21,000	21,000	21,000
Total Project Cost (Federal)	\$ 7,541,000	\$ 8,521,000	\$7,021,000

23. The significant decrease in the current estimate of total contract cost is predicated on refinement of type and quantities of materials to be removed based on extensive field investigations made during preconstruction planning. An increase of about 30% in volumes of materials to be removed is based on more detailed surveys made along the river channel.

#### SCHEDULE FOR DESIGN AND CONSTRUCTION

24. The improvement of Portsmouth Harbor and Piscataqua River has been divided into two segments, the upper reach and lower reach. The upper reach consists of extension of the 35-foot Federal channel from Boiling Rock to a point about 1,700 feet above the Atlantic Terminal Sales dock in Newington with maneuvering basins of the same depth above Boiling Rock and at the head of the authorized project. The lower reach consists of widening the present 35-foot Federal channel at bends by the removal of ledge rock in the vicinity of Henderson's Point, Gangway Rock, Badger's Island, the Maine-New Hampshire Interstate Highway Bridge and Boiling Rock.

25. Improvement of the waterway involving the drilling, blasting, removal and disposal of dredged materials is proposed to be accomplished under one continuing contract, with the provision that work in the upper reach be accomplished first to provide for a 35-foot depth to the wharves in the upper reach of the Piscataqua River. The locomotive resting on the channel bottom in the vicinity of the Interstate Bridge will be removed and disposed of under a separate contract. Present schedule contemplates award of contract for dredging operations in May 1964. Construction will be started in June 1964 under a continuing contract with completion scheduled during Fiscal Year 1967. It is anticipated that construction will be completed in 33 months.

26. Fund requirements for the above schedule is as follows:

Allotted to date	\$ 840,000
Fiscal Year 1965	1,500,000
Fiscal Year 1966	2,500,000
Fiscal Year 1967	<u>2,160,000</u>
Total Funds	\$ 7,000,000

## OPERATION AND MAINTENANCE

27. Maintenance of the project is the responsibility of the United States and will consist of periodic dredging in the upper reach at the location of the present bar just upstream from the Simplex Wire and Cable Co., where moderate shoaling is anticipated. The additional annual maintenance cost of \$10,000 is based on an average annual deposition of 5,000 cu. yds. over that area and also in the turning basin at the upstream limit of the improvement. Annual maintenance costs of the navigation aids has been estimated by the Coast Guard at \$600.

## BENEFITS

28. The benefits expected to accrue from construction of the improvement are the same as those evaluated in the authorizing document. The benefits were evaluated on the basis of present and prospective deep-draft tanker traffic and commerce in crude petroleum and refined petroleum products on the waterway over the life of the project through savings in transportation costs. The benefits anticipated to accrue from the improvement to the whole project amount to \$482,000 annually to be realized in reduced transportation costs for petroleum products.

29. Annual charges computed in the authorizing document were based on a 100-year project life at an interest rate of 2-5/8% of the Federal investment. Since the interest rate at the time of the initial appropriation was fixed at 2-7/8%, the current annual charges are computed at an interest rate of 2-7/8% over a 100-year project life.

### Annual Charges:

Investment	\$7,021,000
Project life	100 years
Interest rate	2-7/8%
Interest and amortization	214,500
Maintenance	<u>10,600</u>
Total Annual Charges	\$ 225,100

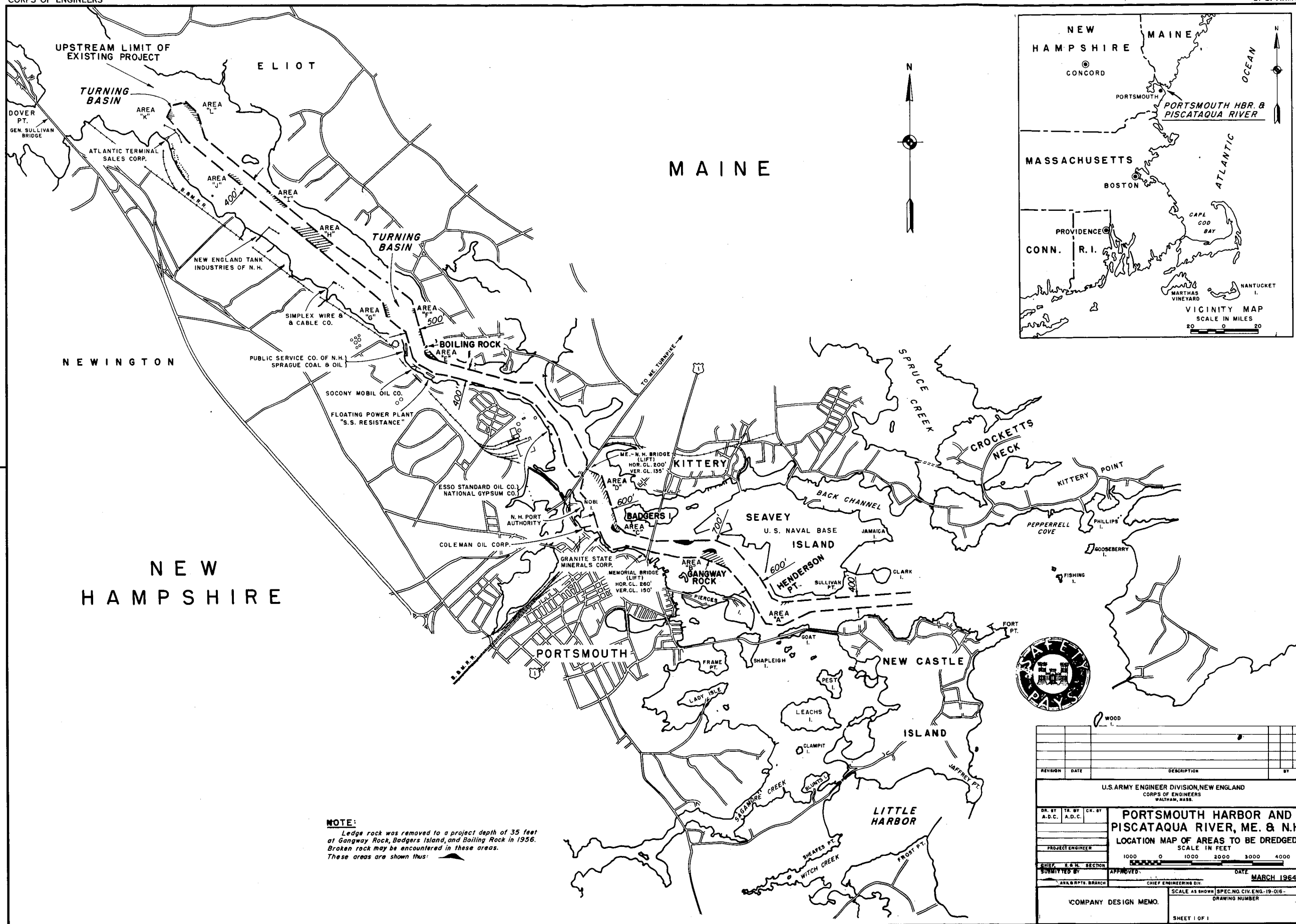
30. A comparison of annual benefits of \$482,000 to the estimated annual charges of \$225,100 yields a current benefit-cost ratio of 2.1 to 1. (Based on a 50-yr. project life, the average annual charges are computed to be \$277,100, yielding a benefit-cost ratio of 1.7 to 1).

### RECOMMENDATIONS

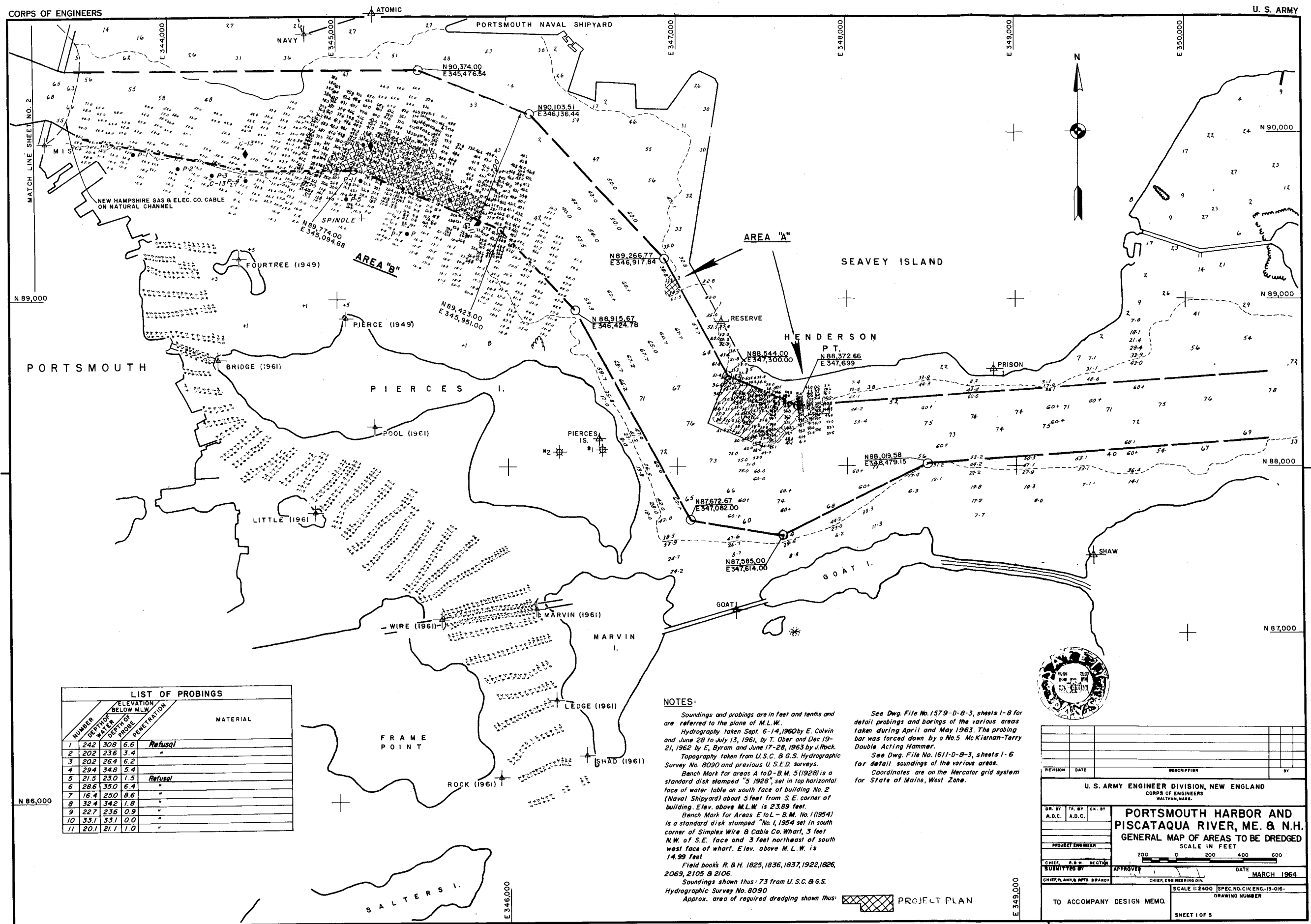
31. The plan of improvement proposed in this Design Memorandum provides for widening the present 35-foot Federal channel at the bends by the removal of ledge rock areas in the vicinity of Henderson Point, Gangway Rock, Badgers Island, the Maine-New Hampshire Interstate Highway Bridge and Boiling Rock, and for extending the present channel upstream from above Boiling Rock to a point about 1,700 feet above the Atlantic Terminal Sales dock in Newington at a depth of 35 feet with maneuvering basins above Boiling Rock and at the head of the authorized project to the same depth. The plan is essentially the same as that described in House Document 482, 87th Congress, 2d Session, and authorized by the River and Harbor Act of 23 October 1962.

32. The project plan as described in this Design Memorandum will serve adequately the present and prospective needs of the waterway and is economically justified. It is recommended that the authorized project be constructed as described herein.

1 Incl  
Map







**NOTE:**

*See sheet 1 for general notes.*

*Surveys of Sept. 15-23, 1960 by E.J. Colvin and June 17-28, 1963 by J. Rock.*

*B. M. 5 1928 is a standard disk stamped "5 1928" set in top horizontal face of water table on south face of building No. 2 (Naval Shipyard) about 5 feet from S.E. corner of building. Elev. above M.L.W. is 23.89 feet.*

*Field books : R. & H. 1783, 1793, 1829, 1825, 2069, 2105, 2106. Soundings shown thus: 41 taken from U.S.C. & G.S. Hydrographic Surveys No. 809 & 8092.*

*Topography from U.S.C. & G.S. Hydrographic Surveys No. 8090 & 8092 and previous U.S.E.D. Surveys.*

*Approx. area of required dredging shown thus: [hatched box]*

NOTE  
 Probing taken with 3/4" iron pipe (pointed) forced down by two men from skiff. Attempted wash probings, but more penetrations gained by forcing, with exception of Probe #11. P-15 made Sept. 16-23, 1960.

